



Alternative: Replace Septic Tanks

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1. Summary of the Alternative

Septic tank/leach field systems are the main wastewater treatment disposal method in use today for virtually all residences and commercial establishments in the planning region outside the service areas of the major central collection, treatment, and disposal systems of Española, Los Alamos, and Santa Fe. Replacing and/or upgrading septic tank treatment and disposal systems in the Jemez y Sangre water planning region would have two primary benefits:

- The quality of the region's groundwater supplies would be better protected.
- A consolidated waste stream from new, centralized treatment facilities would allow the region to apply for more return flow credits and potentially increase their water rights.

Septic tanks are basically clarifiers and biological treatment systems that settle solids and rely on anaerobic or facultative microorganisms to provide biodegradation of organic wastes. Conventional septic tanks and leach fields also include follow-on physical and biological treatment in receiving soils. The technology is well established and, when applied, designed, sited, and installed properly, provides a known and cost-effective level of wastewater treatment as well as adequate protection for receiving groundwater.

However, the use of conventional septic tank/leach field systems can become problematic for various individual and combined reasons such as poor planning, poor design and/or application, poor construction, and lack of adequate maintenance. In some cases, septic tank system failures or the use of septic tanks in an urban or suburban setting where septic tank density is high can cause groundwater pollution and resultant drinking water and human health problems from possible exposure to bacteria and nitrates.





In New Mexico, there are hundreds of small water systems that serve small numbers (30 to 1,500) customers. Approximately 70 such small systems serving approximately 25,000 people exist in the Jemez y Sangre water planning region. Many times, these small water systems have no central wastewater collection system, treatment facility, or disposal system, and their customers therefore rely upon septic tanks/leach fields for wastewater treatment and disposal. If approved by the Office of the State Engineer (OSE), these community water systems can count septic tank wastewater effluent as a return flow. A consolidated waste stream flowing from conventional centralized collection and treatment systems serving these users could effectively increase the amount of return flow credits realistically obtainable.

An additional estimated 46,000 people in the planning region who rely on septic tanks are not connected to these small central water systems, instead obtaining their water from individual domestic wells. Domestic well water rights are not eligible for return flow credits from septic tank wastewater effluent.

This white paper examines two options for eliminating/replacing septic tanks in the planning area:

- *Construct regional wastewater treatment systems for wastewater reuse:* Under this option the planning area would be divided into several collection areas in which central collection, treatment, and disposal facilities would be designed and constructed. After treatment, the wastewater might be reused by reinjecting the effluent to the groundwater or transmitting the effluent to a golf course, ranch, or some other facility that now uses surface water and/or groundwater.
- *Wastewater solutions other than regional wastewater treatment for septic tanks:* Other innovative on-site approaches are available as alternatives to conventional septic tank/leach field wastewater disposal. These more advanced or intensive methods to treat wastewater are intended to produce a higher-quality effluent that protects soils, groundwater, and human health. An example of such a system is a combination gray/black wastewater system, which separates individual on-site residential waste streams so that some wastewater (e.g., from showers and kitchen use) can be stored





and used for landscaping or garden watering, with sanitary wastes being segregated and directed to some on-site (or off-site) wastewater treatment system. This approach to residential wastewater treatment and disposal greatly reduces the daily volume of residential wastewater that, after treatment, is discharged to surface or groundwater. Some of these advanced systems incorporate disposal processes that include evaporation of some of the effluent liquids. Use of such systems may impact return flow credit levels that currently could be assigned to existing groups of septic tank systems.

As indicated above, both of these septic tank replacement options may include reuse of treated wastewater, which would be another, or second, beneficial use of the resource. If a central system pumped treated effluent for some other beneficial use or if gray-water systems were widely used, a reduced amount of water would be withdrawn for consumptive uses such as landscape, garden, stock, and/or ranch land watering. There would also then be a reduction in the primary use return flow credit equal to the consumptive use of the follow-on reuse or gray-water application. This reduction would need to be calculated when determining water savings.

Because of transmission costs, however, reuse of effluent makes sense in this alternative only if some large water user or group of users is within a reasonable distance to the treatment plant(s). This and other issues associated with wastewater reuse are discussed in more detail in a separate white paper (DBS&A, 2002).

Replacement of septic tanks will not necessarily provide more water to the region. The effluent from septic tanks currently recharges the aquifers, thus impacting the supply available to domestic wells, and the potential return flow credits available if the effluent were treated in a centralized system are not necessarily more than those currently available for septic tank seepage. Thus this alternative will not increase the amount of water allowed for full consumption under a water right.

Nevertheless, in considering new developments, the water that can be lost on new septic tanks, particularly those located distant from the source of supply, should be considered by planners. In addition, replacing septic tanks with a centralized or on-site system that allows for reuse of the effluent could reduce the demand, improve system efficiency, and protect the water





resources. Regardless of any potential increase in water supply, the water quality benefits alone may make this an option worth pursuing.

2. Technical Feasibility

For a large portion of the planning area in and around Española and the Pojoaque Pueblo, an excellent in-depth study has been completed that examines the issues of this white paper (ASCG Incorporated, 2001). Similar studies will be needed throughout the planning area to properly evaluate options and present costs and benefits so that decision-makers have enough information to plan for the future.

One very important point that is examined in the ASCG study is the need for cooperation and inclusion of all the pueblos in such planning, project implementation, and facility management. As an example of the need for this cooperation with the pueblos, the *North Central New Mexico Water Quality Plan* also notes that septic tank systems are expected to still be used by many residents, regardless of the option adopted for its management area, and the disposal of septage from these systems will thus need to be addressed. It notes:

Septic tanks will continue to be used as an interim wastewater treatment and disposal measure for many of the Region's residents until sewer service is eventually extended. Many of these on-site systems are owned by non-Indians who live within the boundaries of the Region's six Pueblos. An enforceable management plan for properly maintaining these systems and disposing of their septage is needed. In specific, this management plan needs to resolve concerns by the Region's local units of governments and the six Tribal governments over who has jurisdiction to enforce septic tank management.

2.1 Regional Wastewater Treatment Systems

The technology exists to collect, centrally treat, and dispose of all wastewater now generated by rural residents of the planning area. In the normal course of an area's growth, it is not unusual for housing units to become denser and for wastewater treatment to eventually be centralized. The decision to centralize wastewater treatment is normally taken for public safety and health





and environmental protection, as well as for economic reasons. In some parts of the planning area, the density of rural housing lends itself to this consideration now.

This alternative would involve potentially complicated federal and state permitting for the discharge of some or all of the treated wastewater effluent to surface water and/or groundwater or for some reuse purpose. Return flow credits might also be impacted depending on the type of reuse option used.

The planning, design, and construction of regional wastewater systems would require contracted external professional assistance and, after completion, qualified regional management, operations, and maintenance staff. Reuse of wastewater might also require:

- More person hours and material/equipment costs for overall operations and maintenance than a treatment plant that simply discharges its effluent to some receiving waters
- More sophisticated treatment than simple secondary treatment unit to produce an effluent of higher quality for reuse applications. While golf courses might be able to use effluent from secondary treatment processes, some other applications might require smaller concentrations of solids or a reduction in some other physical or chemical constituent of the treated wastewater effluent.

An excellent source of information on small conventional wastewater systems relevant to this alternative is the U.S. Environmental Protection Agency's Office of Wastewater Management-Small Communities (<http://www.epa.gov/OSM/smcomm.htm>).

2.2 Alternate On-Site Wastewater Treatment Solutions

Innovative or advanced on-site wastewater treatment/disposal systems are the subject of considerable attention, study, and practice. These systems, which may either enhance or replace conventional septic tank/leach field systems, include the use of filtration, disinfection, and other biological processes in addition to clarification. Descriptions of these systems and





their use are beyond the scope of this white paper; however, information on such on-site technology is available at West Virginia University's National Small Flows Clearinghouse (<http://www.estd.wvu.edu/nsfc>). Another excellent resource on this subject is the National Onsite Wastewater Recycling Association, Inc. (NOWRA) (<http://www.nowra.org/who.shtml>).

In an effort to address serious groundwater pollution problems, municipalities may consider adopting regulations that call for advanced on-site wastewater treatment technologies for most new residences that would have otherwise installed simple septic tanks. Ordinances may also include wording that requires existing system compliance over time. Adoption of such regulations would represent a solid beginning to achieving better control and management of on-site wastewater in New Mexico.

The planning, design, and construction of improved on-site wastewater treatment systems requires the use of more professional engineering assistance than the installation of conventional septic tank/leach field systems. Such systems are also more costly and require higher levels of operations and maintenance skills and annual activities.

The use of gray-water residential-type systems involves modifications of residential plumbing to separate waste streams and requires equalization/storage tanks and distribution systems. These systems also require new operation and maintenance responsibilities for rural homeowners that will add to existing homeowner maintenance costs.

3. Financial Feasibility

The Jemez y Sangre water planning region is estimated to include approximately 24,500 septic tank/leach-field systems. The costs to replace these systems with either regional wastewater treatment systems or other on-site technologies are discussed in Sections 3.1 and 3.2.

3.1 Regional Wastewater Treatment Systems

The cost to plan, design, build, and then operate and maintain a system of smaller collection, treatment, and disposal facilities would be high. As an example, assume that 80 percent of all





residences now on septic systems are tied into a group of small wastewater treatment plants and that the distribution of the rural housing in the planning area dictates that each of these plants have an average initial treatment capacity of 200,000 gallons per day. Given these assumptions, 12 new, small wastewater treatment plants would be required in the planning region. Assuming that these regional systems included only conventional secondary treatment, conventional gravity-type collection systems, and disposal to groundwater or to some other existing water user, this alternative has an estimated capital cost exceeding \$95 million. The true cost of such a project would also include right-of-way acquisition, recurring annual operations and maintenance, and future parts and equipment replacement costs.

At least some of the costs of developing central wastewater collection and treatment systems would be passed onto rural residents. In contrast to their current relatively low and periodic ongoing costs associated with conventional septic tanks, these residents would receive a monthly wastewater bill to cover their share of the management, operations, and maintenance of the small central systems.

While the benefits of this option would be mainly in the areas of human health and safety and environmental protection (e.g., improved drinking water quality and groundwater protection), some cost savings may be realized. If some of the treated wastewater were reused, the value of the surface and/or groundwater not used as a result of the reuse application(s) would be saved. If 200,000 gallons of treated wastewater were reused each day and the cost of this water was \$5,000 per acre-foot, the resulting savings would be a little less than \$13 million. Considerable additional savings might also be realized if the user(s) would have otherwise bought needed water at a higher cost, such as that charged each month to public water system customers (a typical charge is \$2 per 1,000 gallons).

At first glance, the capital costs to develop such a system of small central systems, even when they include reuse, would appear to be much greater than the value of the water saved. However, the value of human health and safety improvements due to water quality benefits, although not specifically considered here, would be substantial. Some external federal and state funding for such construction might be available depending on the level of need established.





3.2 Alternate On-Site Wastewater Treatment Solutions

Again, the capital costs alone to employ these systems appear to be huge in comparison to the value of saved water. The cost to bring new systems on line as a result of new home construction would be between \$6,000 and \$10,000 compared to a conventional septic tank/leach field system cost of approximately \$2,400. Gray-water system conversion on existing residences might be priced at a similar estimated capital cost per residence. Thus the costs to upgrade 80 percent of the approximately 24,500 septic tank/leach-field systems in the planning area to an advanced on-site system, even at the low end of the scale (i.e., \$6,000 each), would be more than \$110 million.

In contrast to regional wastewater systems, the costs of replacing septic systems with advanced on-site treatment systems would likely be borne entirely by individual property owners, although external funding is available for some small community on-site projects. Instituting a wastewater ordinance requiring alternative on-site wastewater systems to septic systems (Section 2.2) would result in much greater on-site wastewater system costs for new (\$6,000 to \$10,000) and retrofitted (\$3,000 to \$7,000) residences than the cost to maintain a septic tank system (assuming that a comparison of the cost of maintaining a failing septic tank system with the cost for a functioning advanced system is valid).

Again, however, the value of groundwater improvements and human health and safety benefits associated with system upgrades might be the deciding factor in adopting mandates for advanced on-site treatment. In his paper *Septic Tanks, Good or Evil*, Dr. Richard Rose, P.E., of the NMED Construction Programs Bureau, notes:

... decentralized management has captured national attention and is promoted by EPA because of the potential for substantial reduction in wastewater construction costs. It can provide both short and long term protection of the environment and does not preclude "Big Pipe" options in the future. Funding for the decentralized approach is available from mainstream funding agencies, such as NMED and USDA Rural Utility Service.





This paper (Rose, 2001) also discusses in detail the debate regarding on-site versus centralized treatment and describes an ongoing EPA-funded, NMED-implemented demonstration project in Willard, New Mexico.

4. Legal Feasibility

The legal issues which would arise when examining whether replacing such septic tanks and constructing regional wastewater systems or some other type of water treatment system will increase the supply of water available in the region center around the issues arising from the construction of regional wastewater systems. If the system were to treat water and return water to, for example, the Rio Grande, a number of federal laws would govern the construction and operation of such system. For example, the National Environmental Policy Act (NEPA) would come into play. NEPA is a federal law that addresses process, not substance. It dictates the steps that must be taken to analyze environmental impacts of actions; it does not place limits on what actions may be taken. In a nutshell, NEPA requires that an analysis of environmental impacts be prepared for all “major federal actions significantly affecting the quality of the human environment” (42 U.S.C. §4332). “Major federal actions” that must be subject to a NEPA analysis include “projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies” (40 C.F.R. 1508.18(a)). For our purposes, we can presume that any action that either receives significant federal funding or has federal agency involvement will have to be subject to a NEPA environmental analysis. Most likely, a regional wastewater treatment system would receive such funding.

Further, once a regional wastewater system is operational, it can only discharge treated water into the “waters of the United States” under a permit issued pursuant to the Clean Water Act (33 U.S.C. §1251 *et seq.*) Such permits are called National Pollutant Discharge Elimination System (NPDES) permits and are implemented to control water pollution by regulating point sources that discharge pollutants into surface waters.

A further issue arises in looking at the return flow ramifications associated with replacing septic systems with a regional wastewater system or other type of treatment regime. Depending on





the depth to groundwater, individual septic systems return a certain amount of water to the aquifer. Likewise, wastewater treatment plants which discharge to a surface system also return water to the system. Therefore, a technical question arises as to which type of treatment regime returns more water to the system.

An important issue to municipalities, counties, and other entities that supply water and treat wastewater is the reuse of return flows. In some instances, such an entity may wish to reuse effluent to meet growing municipal demands. Such reuse will result in less water returning to the river system for use by other users and, consequently, raises questions of whether State Engineer approval is necessary and whether downstream users may oppose the reuse. Another type of reuse occurs when the water user seeks to increase its diversions based upon the amount of return flows it makes to the river system. Diversions may be increased by approval by the State Engineer of a return flow plan that has the effect of crediting the water user with the return flows and allowing diversions to increase in the same amount.

From a legal standpoint, a right to divert water provides its user with two types of water: the diversion portion, which equals the total amount withdrawn from the stream system, and the consumptive use portion, which is the portion that is consumed. Any amount left over that returns to the stream system by seepage, discharge or even injection is a return flow. Where the State Engineer has already issued a permit to divert a specified quantity of water, the State Engineer's authority is limited. Other than the power to prohibit a user from using more water than permitted, the State Engineer's authority is restricted to evaluating proposed new uses or new points of diversion to determine whether the change would impair other users or be contrary to public welfare or conservation. Accordingly, the State Engineer lacks jurisdiction to regulate the implementation of a reduced discharge system, as long as the system would not result in a use of municipal water in a place, for a purpose, or in an amount not already allowed by the city's permit.

In the case of *Reynolds v. City of Roswell* (99 N.M. 84, 654 P.2d 537 (1982)), the New Mexico Supreme Court addressed the issue of the State Engineer's imposition of a return flow requirement on a city permit that previously contained no condition. The court held that the requirement was unlawful, concluding that all of the water appropriated under the permit could





be used and consumed by the city, as the water was "artificial" water belonging to the city (99 N.M. 87-88, 654 P.2d 540-1).

A more complex question concerns a municipality's ability to reuse waters when some or all of its permits contain discharge requirements. A return flow condition will typically require a city to return all measurable return flow to the river, including sewage effluent, or may state a percentage of pumping, such as 30 percent, that must be returned to the river system. Under these circumstances, the municipality may not use more than its consumptive use right. But it could reuse some or all of its effluent if it reduced its pumping correspondingly, so that the total consumptive use did not increase. In other words, by limiting pumping under a permit to the consumptive right and replacing any consequent shortfall in municipal supply with effluent, the municipality could make use of its return flows within its legal authority. Again, as long as the substitution of effluent did not result in a change in the purpose or place of use of municipal water, no State Engineer approval would be necessary, in most instances.

Alternatively, a city that is discharging and returning to the stream system more effluent than is required could seek return flow credits for the discharge. A return flow credit would allow the city to offset the effects of increased diversions for use elsewhere in its water system. Such offsets could allow additional pumping from municipal wells. State Engineer approval would be required for increased diversions based on return flow credits.

With respect to challenges by downstream users, the issue is one of title to water once it is released back into a public watercourse. New Mexico law contains an exemption for artificial waters from the general rule that waters returned to the river system are appropriable public waters. The fact that a city has discharged waters in the past does not extinguish the city's right to its use and consumption and, further, does not create a right to the waters in another, and a downstream user could not assert a claim against the city to the use of the discharged effluent, absent agreement by the city (§72-5-27 NMSA 1978 (1997 Repl. Pamp.)).





5. Effectiveness in Either Increasing the Available Supply or Reducing the Projected Demand

The effectiveness of septic tank replacement in increasing available supply or reducing projected demand is limited. In some cases it may have some effect on the available supply by allowing the region to apply for more return flow credits and potentially increase their water rights. In addition, it may effectively reduce demand by offering more possibilities for reuse of treated wastewater or gray water (although such reuse raises some public health and safety issues). These possibilities are discussed in Sections 5.1 and 5.2.

5.1 Regional Wastewater Treatment Systems

If the total population of the planning area is assumed to be 163,000 and 90 percent of all residents of Santa Fe, Los Alamos and Española are connected to their municipality's central wastewater collection, treatment, and disposal system, the approximate number of planning area residents who use septic tanks is estimated at just over 73,000, with a corresponding 24,500 septic tanks. If the wastewater generated by a rural resident on a septic tank system is estimated to be 40 gallons per day, the total amount of wastewater that flows to septic tanks in the planning area each day will be close to 2.9 million gallons. This flow equates to approximately 3,125 acre-feet of available return flow liquid wastewater per year.

However, the amount of additional return flow credits available to the region as a result of replacing septic tanks with regional systems is not necessarily significantly more than current potential return flow credits. Even with no reuse, community water systems (excluding individual domestic wells) could potentially receive OSE approval for return flow credit. In addition, the return flow credit might be reduced by the amount of wastewater effluent from a central system that is consumed by another beneficial use. Some portion of the return flow credit would be available at the end of the second beneficial use. How much water is consumed and how much can then be claimed as a return flow credit in the second use will determine the effectiveness of this alternative in increasing the legally available supply.





Reuse of treated effluent would presumably save water now withdrawn from surface water and/or groundwater. Assuming that all of the treated effluent could be reused, the reduction in existing demand is estimated to be less than 2,500 acre-feet.

5.2 Alternate On-Site Wastewater Treatment Solutions

Advanced wastewater treatment systems offer no increase in available supply. The employment of gray water systems will result in a reduction of projected demand through the use of gray water in applications that would otherwise require surface water and/or groundwater. If gray-water systems were retrofitted to all residences and small businesses that currently use septic systems, an estimated 70 percent of the normal domestic flow, or just less than 1,750 acre feet, could be reused. However, the return flow credit available for reused wastewater or gray-water is probably smaller than if the gray water was discharged directly to a conventional septic tank, because some of the water will be lost to evapotranspiration during outdoor applications.

6. Environmental Implications

Replacement of septic tanks would have NEPA implications in archaeological and biological terms but none that would stop the projects. Cultural remains and endangered species habitat would have to be identified and avoided. Some floodway, floodplain, and perhaps wetlands issues under Section 404 of the Clean Water Act would be associated with the construction of regional wastewater treatment systems.

Considering the fact that many rural septic systems are faulty and often located too close to surface water and wells, replacing septic tanks would reduce contamination of surface water and groundwater and therefore enhance human health and safety. Constructing regional wastewater treatment systems would yield greater streamflow downstream, but would reduce locally available water by diminishing local groundwater recharge and seepage to surface water. If alternative wastewater treatment systems are local and small-scale, the discharge could increase local surface streamflow.





7. Socioeconomic Impacts

The Jemez y Sangre region of northern New Mexico is distinguished by its rural and agricultural character, predominantly Indian and Hispano population, localized land-based economies, and pockets of persistent poverty. In particular, its Indian and Hispano populations represent some of the most unique cultures in the world, products of a long history of continuous human habitation, adaptation, and cultural blending. Land-based Indian and Hispano cultures still thrive, carrying on centuries-old cultural traditions that include distinctive land-use and settlement patterns, agricultural and irrigation practices, natural resource stewardship practices, social relations, religious activities, and architecture. An example is the ancient acequia tradition, which is vital both as a sustainable irrigation system for subsistence and market agriculture and as part of the social glue that holds together rural communities.

The survival of these deeply rooted local traditions is essential for the continuity of rural culture and communities and, in turn, for the local tourism industry, which is built in large part upon the singular cultural and historical personality of the region. Preservation of these traditions is therefore an important consideration in determining the socioeconomic and cultural impacts of regional water planning.

Considering the fact that many rural septic systems are faulty and often located too close to surface water and wells, replacing septic tanks would have the direct socioeconomic and cultural benefits of reducing contamination of surface water used for consumption and irrigation and reducing contamination of groundwater used for domestic wells.

If wastewater treatment systems were local and small-scale, replacing septic systems would have the additional direct benefit of increasing local streamflow for irrigation and other local beneficial use. Planners should consider “living machines” (natural biological treatment using greenhouse plants), constructed wetlands, or other small-scale, natural, environmentally friendly alternatives. Administration of local wastewater treatment systems could be easily integrated into rural community structure through existing institutions such as mutual domestic water associations or acequia associations.





Assuming that any effluent water quality issues can be overcome, constructing regional wastewater treatment systems would yield greater streamflow for downstream users, but would have a negative socioeconomic and cultural impact on rural upstream users, reducing available water by diminishing local groundwater recharge and seepage to surface water. In addition, rural users would likely see an increase in their monthly wastewater treatment costs, which could be perceived as a threat to an established rural lifestyle. The cost of retrofitting or replacing an existing septic system with an advanced or gray water wastewater system would be onerous on the rural poor or lower middle class. Such additional expense for the rural poor or lower middle class may not be seen as politically acceptable and could result in some polarization of urban and rural residents in the planning area. Conversely, increasing available water would probably reduce the cost for all water users.

8. Actions Needed to Implement/Ease of Implementation

The actions needed to construct regional wastewater treatment systems for wastewater reuse are:

- Establish a regional authority.
- Determine location(s) for regional treatment plant(s).
- Investigate available reuse options.
- Gather public input.
- Plan, design, and construct wastewater collection, treatment and reuse facilities.
- Identify and secure financial assistance from large external funding source to help cover the capital costs over the life span of such a project (i.e., 10 to 15 years).

The planning and implementation of this option would be time consuming.

To implement wastewater solutions other than regional wastewater treatment for septic tanks, the political entities in the planning area would have to enact some sort of enabling legislation. Some external funding source might be needed to help the rural poor and lower middle class fund the improvements. Any public opposition would need to be overcome.





9. Summary of Advantages and Disadvantages

The advantages and disadvantages of the options for replacing septic tanks are summarized in Table 1. In general, both options examined here seem to have high cost and low value added in terms of water saved. The planning-area-wide discussion in this white paper does not, however, consider smaller locations and areas within the planning region that might better individually lend themselves to these alternatives. Examples exist in other areas of smaller-scale implementation of the options discussed herein that were successful in conserving water. Opportunities to implement these alternatives in smaller areas in a cost-effective, water conserving manner need to be studied and evaluated. Successfully and cost-effectively implementing these alternatives in such places where they make sense will result in water savings through projected future demand reductions.

Table 1. Advantages and Disadvantages of Septic Tank Replacement Options

Septic Tank Replacement Option	Advantages	Disadvantages
Regional wastewater treatment systems	<ul style="list-style-type: none">• Reduced projected demand• Technology available• Minimum environmental issues• Improved human health and safety• Improved groundwater quality	<ul style="list-style-type: none">• Cost high• Value of water saved low• Politically difficult• Negative cultural impact, monthly charges• Potential medium-difficulty environmental issues
Alternate on-site wastewater treatment solutions	<ul style="list-style-type: none">• Reduced projected demand with gray water system• Technology available• Minimum environmental issues• Improved human health and safety• Improved groundwater quality	<ul style="list-style-type: none">• Cost high• Value of water saved low• Politically difficult• Negative cultural impact, high costs

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